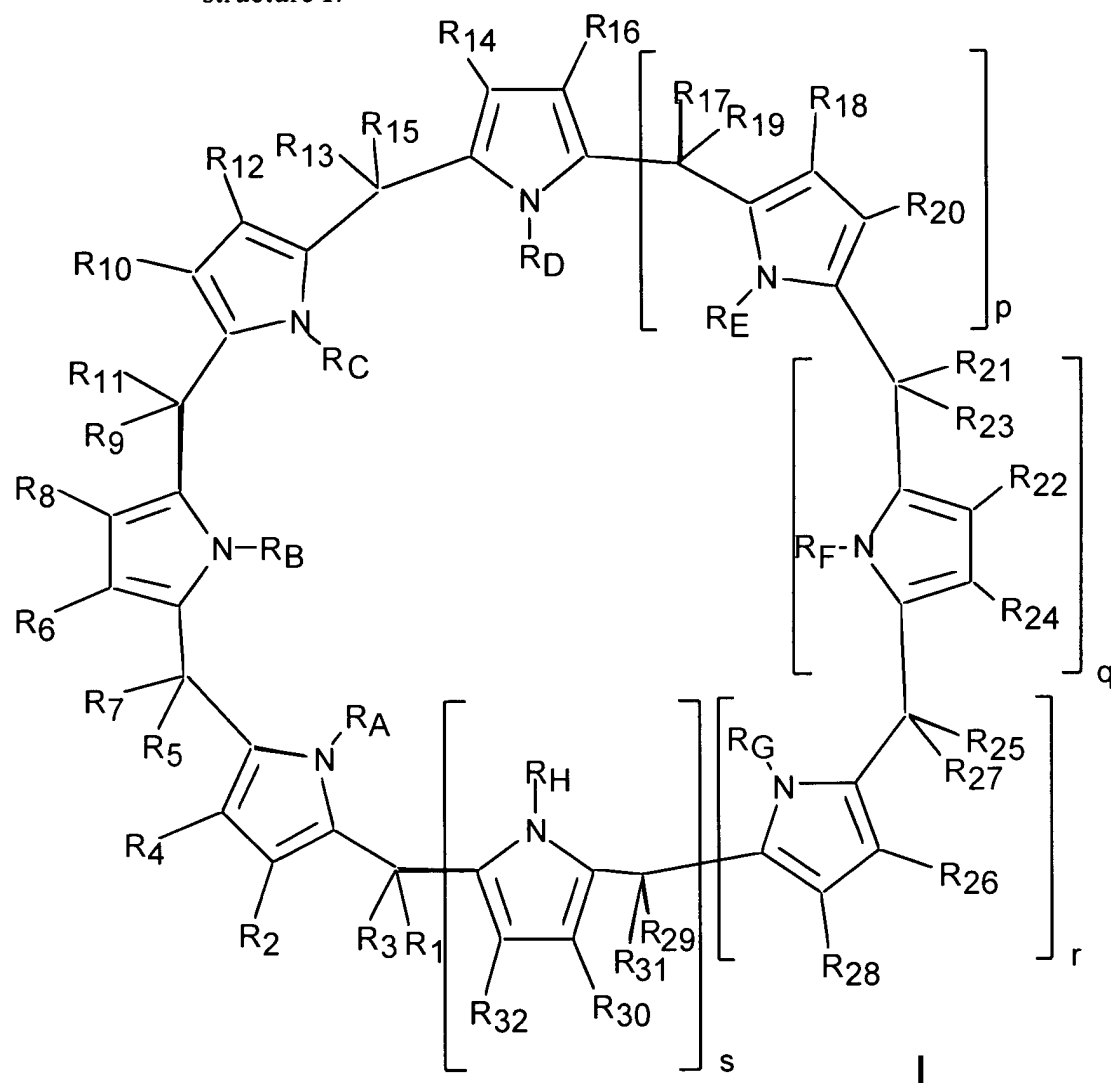


BI 1. (Amended) A composition comprising a calix[n]pyrrole macrocycle that has n pyrrole rings linked in  $\alpha$  positions via  $sp^3$  hybridized *meso*-carbon atoms, the *meso*-carbon atoms bound to an atom other than hydrogen, where n is 4, 5, 6, 7, or 8; the macrocycle noncovalently-complexed to a molecular or anionic species.

4. (Amended) The composition of claim 1 wherein the calix[n]pyrrole macrocycle has structure I:



wherein

when n is 4,  $p = q = r = s = 0$ ,  $R_1 - R_{16}$  are independently substituents as listed in paragraph i) below, and  $R_A - R_D$  are independently substituents as listed in paragraph ii) below;

when  $n$  is 5,  $p = 1$ ,  $q = r = s = 0$ ,  $R_1$  to  $R_{20}$  are independently substituents as listed in paragraph i) below, and  $R_A - R_E$  are independently substituents as listed in paragraph ii) below;  
 when  $n$  is 6,  $p = q = 1$ ,  $r = s = 0$ ,  $R_1$  to  $R_{24}$  are independently substituents as listed in paragraph i) below, and  $R_A - R_F$  are independently substituents as listed in paragraph ii) below;  
 when  $n$  is 7,  $p = q = r = 1$ ,  $s = 0$ ,  $R_1$  to  $R_{28}$  are independently substituents as listed in paragraph i) below, and  $R_A - R_G$  are independently substituents as listed in paragraph ii) below;  
 when  $n$  is 8,  $p = q = r = s = 1$ ,  $R_1$  to  $R_{32}$  are independently substituents as listed in paragraph i) below, and  $R_A - R_H$  are independently substituents as listed in paragraph ii) below;

- i) hydrogen, halide, hydroxyl, alkyl, alkenyl, alkynyl, aryl, alkylaryl, nitro, phospho, formyl, acyl, hydroxyalkyl, alkoxy, hydroxyalkoxy, hydroxyalkenyl, hydroxyalkynyl, saccharide, carboxy, carboxyalkyl, carboxamide, carboxamidealkyl, amino, amido, aminoalkyl, phosphoalkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, tetrahydropyran, tetrahydrothiapyran, thioalkyl, haloalkyl, haloalkenyl, haloalkynyl, alkyl ester, a site-directing molecule, a catalytic group, a reporter group, a binding agent, or a couple that is coupled to a site-directing molecule, to a catalytic group, to a reporter group, or to a binding agent;
- ii) hydrogen, alkyl, aminoalkyl, alkylsulfone, carboxy alkyl, carboxamidealkyl, phospho alkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, haloalkyl, aryl, N-oxide, dialkylamino, carbamate, or arylsulfonyl;

wherein odd-numbered R-substituents are other than hydrogen.

B2 91. (Amended) A composition comprising a calix[m]pyridino[n]pyrrole macrocycle that has  $m$  pyridine rings and  $n$  pyrrole rings linked in  $\alpha$  positions via  $sp^3$  hybridized *meso*-carbon atoms, the *meso*-carbon atoms bound to an atom other than hydrogen, where  $m + n$  is 4, 5, 6, 7, or 8 and  $m$  and  $n$  are other than 1 and 3 or 2 and 2, respectively; the macrocycle noncovalently complexed to a molecular or cationic species.

Claims 95-117 were added as follows.

B<sup>3</sup> 95. The composition of Claim 4 wherein at least two substituents of paragraph i) or ii) are coupled to form a bridged structure, and when coupled to form a bridged structure, nonbridged substituents are as defined in paragraph i) or ii).

96. The composition of Claim 4 wherein the calix[n]pyrrole macrocycle is  $\beta$ -substituted where at least one even-numbered R-substituent is other than hydrogen.

97. The composition of Claim 4 wherein at least one odd numbered R substituent is carboxy.

98. The composition of Claim 4 wherein at least one odd numbered R substituent is alkyl ester.

99. The composition of Claim 4 wherein at least one even numbered R substituent is carboxy.

100. The composition of Claim 4 wherein at least one even numbered R substituent is alkyl ester.

101. The composition of Claim 1 where the macrocycle is complexed with an anionic species and the anionic species is a halide anion.

102. The composition of Claim 101 wherein the halide anion is chloride.

103. The composition of Claim 101 wherein the halide anion is fluoride.

104. The composition of Claim 1 where the macrocycle is complexed with an anionic species and the anionic species is a molecule containing a phosphate.

105. The composition of Claim 1 where the macrocycle is complexed with an anionic species and the anionic species is an oxoanion.

106. The composition of Claim 1 where the macrocycle is complexed with an anionic species and the anionic species is a radioactive anion.

B3  
cont

107. The composition of Claim 1 where the macrocycle is complexed with a molecular species and the molecular species is an alcohol.

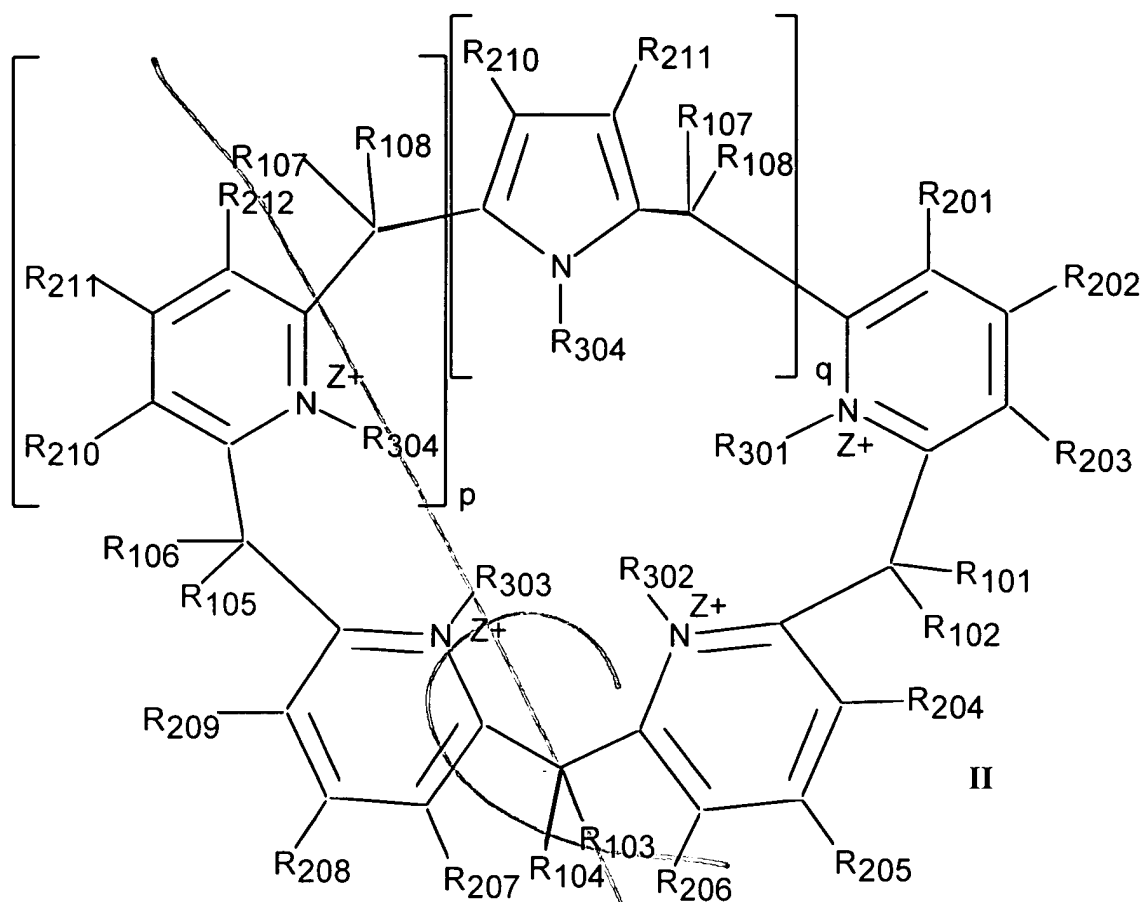
108. The composition of Claim 1 where the macrocycle is complexed with a molecular species and the molecular species is urea.

109. The composition of Claim 1 where the macrocycle is complexed with a molecular species and the molecular species is an ion pair.

110. The composition of Claim 1 where the macrocycle is complexed with a molecular species and the molecular species is a zwitterion.

~~111. A composition comprising a calix[m]pyridino[n]pyrrole macrocycle that has m pyridine rings and n pyrrole rings linked in  $\alpha$  positions via  $sp^3$  hybridized *meso*-carbon atoms, the *meso*-carbon atoms bound to an atom other than hydrogen, where  $m + n$  is 4, 5, 6, 7, or 8 and m and n are other than zero; the macrocycle noncovalently-complexed to a molecular or anionic species forming a supramolecular ensemble.~~

112. The composition of Claim 111 wherein the calix[m]pyridino[n]pyrrole macrocycle has structure II:



wherein m designates a number of pyridines in the macrocycle and n designates a number of pyrroles in the macrocycle;

$m+n=4$ ;

m is other than 1 or 2;

when m is 4,  $n = 0$ ,  $p = 1$ ,  $q = 0$ , R101 to R108 and R201 to R212 are independently substituents as listed in paragraph i) below, and R301 - R304 are independently substituents as listed in paragraph ii) below;

when m is 3,  $n = 1$ ,  $p = 0$ ,  $q = 1$ , R101 to R108 and R201 to R211 are independently substituents as listed in paragraph i) below, and R301 - R304 are independently substituents as listed in paragraph ii) below;

i) hydrogen, halide, hydroxyl, alkyl, alkenyl, alkynyl, aryl, alkylaryl, nitro, phospho, formyl, acyl, hydroxyalkyl, alkoxy, hydroxyalkoxy, hydroxyalkenyl, hydroxyalkynyl, saccharide, carboxy, carboxyalkyl, carboxamide, carboxamidealkyl, amino, amido, aminoalkyl, phosphoalkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, tetrahydropyran, tetrahydrothiapyran, thioalkyl, haloalkyl, haloalkenyl, haloalkynyl, alkyl ester, a site-directing molecule, a catalytic group, a

reporter group, a binding agent, or a couple that is coupled to a site-directing molecule, to a catalytic group, to a reporter group, or to a binding agent;

B3  
cont

ii) a lone pair of electrons, hydrogen, alkyl, aminoalkyl, alkylsulfone, carboxy alkyl, carboxyamidealkyl, phospho alkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, halo alkyl, aryl, N-oxide, dialkylamino, carbamate, or arylsulfonyl;

or

at least two substituents are coupled to form a bridged structure, and when coupled to form a bridged structure, nonbridged substituents are as defined herein in paragraph i) or ii);

wherein  $R_{101}$ - $R_{108}$  are other than hydrogen;

wherein when  $R_{301}$ - $R_{304}$  is other than a lone pair of electrons, Z is 1;

wherein when  $R_{301}$ - $R_{304}$  is a lone pair of electrons, Z is 0.

113. The composition of Claim 111 where

$m+n=5, 6, 7, \text{ or } 8$ ;

each pyridine or pyrrole  $\alpha$ -carbon is bound to another pyridine or pyrrole  $\alpha$ -carbon *via* one non hydrogen-linked  $sp^3$  hybridized *meso*-carbon;

each  $sp^3$  hybridized *meso*-carbon is further independently bonded to a halide, hydroxyl, alkyl, alkenyl, alkynyl, aryl, alkylaryl, nitro, phospho, formyl, acyl, hydroxyalkyl, alkoxy, hydroxyalkoxy, hydroxyalkenyl, hydroxyalkynyl, saccharide, carboxy, carboxyalkyl, carboxyamide, carboxyamidealkyl, amino, amido, aminoalkyl, phosphoalkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, tetrahydropyran, thioalkyl, haloalkyl, haloalkenyl, haloalkynyl or alkyl ester group; to a site-directing molecule; to a catalytic group; to a reporter group; to a binding agent; or to a couple that is coupled to a site-directing molecule, to a catalytic group, to a reporter group, or to a binding agent;

each pyridine  $\beta$  carbon, pyrrole  $\beta$  carbon and pyridine  $\gamma$  carbon is independently bonded to a hydrogen, halide, hydroxyl, alkyl,

B3  
Cont

alkenyl, alkynyl, aryl, alkylaryl, nitro, phospho, formyl, acyl, hydroxyalkyl, alkoxy, hydroxyalkoxy, hydroxyalkenyl, hydroxyalkynyl, saccharide, carboxy, carboxyalkyl, carboxyamide, carboxyamidealkyl, amino, amido, aminoalkyl, phosphoalkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, tetrahydropyran, thioalkyl, haloalkyl, haloalkenyl, haloalkynyl, alkyl ester group; to a site-directing molecule; to a catalytic group; to a reporter group; to a binding agent; or to a couple that is coupled to a site-directing molecule; to a catalytic group; to a reporter group, or to a binding agent;

each pyridine or pyrrole nitrogen is bound to a lone pair of electrons, hydrogen, alkyl, aminoalkyl, alkylsulfone, carboxy alkyl, carboxyamidealkyl, phospho alkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, halo alkyl, aryl, N-oxide, dialkylamino, carbamate, or arylsulfonyl;

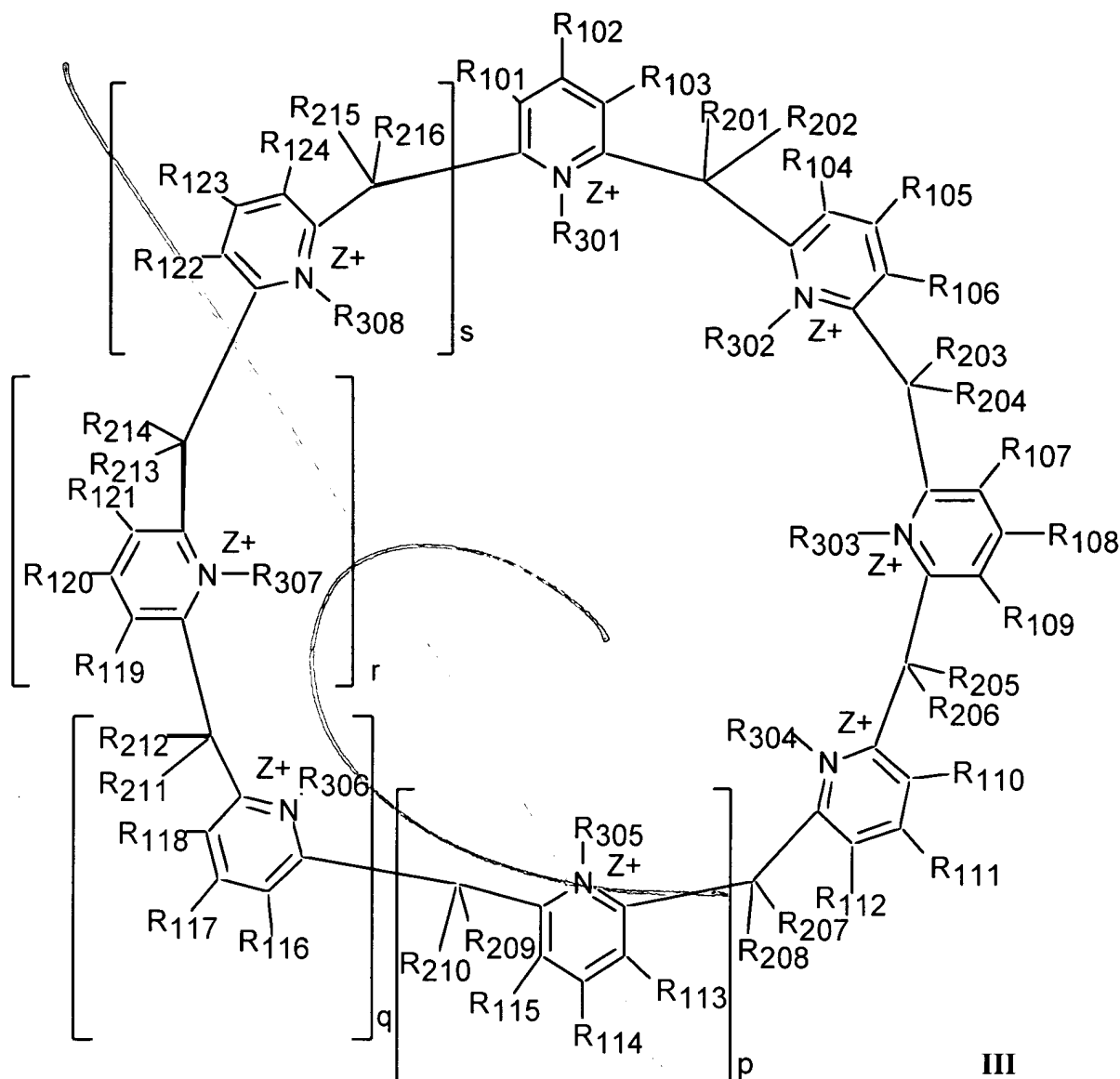
or

at least one  $sp^3$  hybridized *meso*-carbon, pyridine  $\beta$ -carbon, pyrrole  $\beta$ -carbon, pyridine  $\gamma$  carbon, pyrrole nitrogen or pyridine nitrogen is coupled to form a bridged structure to itself or to another  $sp^3$  hybridized *meso*-carbon, pyridine  $\beta$ -carbon, pyrrole  $\beta$ -carbon, pyridine  $\gamma$  carbon, pyrrole nitrogen, or pyridine nitrogen; and when coupled to form a bridged structure, non-bridged atoms are as defined for an  $sp^3$  hybridized *meso*-carbon, pyridine  $\beta$ -carbon, pyrrole  $\beta$ -carbon, pyridine  $\gamma$  carbon, pyrrole nitrogen, or pyridine nitrogen.

~~114.~~ A composition comprising a calix[m]pyridine macrocycle that has m pyridine rings linked in  $\alpha$  positions via  $sp^3$  hybridized *meso*-carbon atoms, the *meso*-carbon atoms bound to an atom other than hydrogen, where m is 4, 5, 6, 7, or 8; the macrocycle noncovalently complexed to a molecular or cationic species.

115. The composition of Claim 114 wherein the calix[m]pyridine macrocycle has structure III:

B3  
Cont



wherein m is 4, 5, 6, 7 or 8;

when m is 4,  $p = q = r = s = 0$ , R101 to R112 and R201 to R208 are independently substituents as listed in paragraph i) below, and R301 - R304 are independently substituents as listed in paragraph ii) below;

when m is 5,  $p = 1$ ,  $q = r = s = 0$ , R101 to R115 and R201 to R210 are independently substituents as listed in paragraph i) below, and R301 - R305 are independently substituents as listed in paragraph ii) below;

when m is 6,  $p = q = 1$ ,  $r = s = 0$ , R101 to R118 and R201 to R212 are independently substituents as listed in paragraph i) below, and R301 - R306 are independently substituents as listed in paragraph ii) below;



B3  
cont

when m is 7,  $p = q = r = 1$ ,  $s = 0$ , R<sub>101</sub> to R<sub>121</sub> and R<sub>201</sub> to R<sub>214</sub> are independently substituents as listed in paragraph i) below, and R<sub>301</sub> - R<sub>307</sub> are independently substituents as listed in paragraph ii) below;

when m is 8,  $p = q = r = s = 1$ , R<sub>101</sub> to R<sub>124</sub> and R<sub>201</sub> to R<sub>216</sub> are independently substituents as listed in paragraph i) below, and R<sub>301</sub> - R<sub>308</sub> are independently substituents as listed in paragraph ii) below;

i) hydrogen, halide, hydroxyl, alkyl, alkenyl, alkynyl, aryl, alkylaryl, nitro, phospho, formyl, acyl, hydroxyalkyl, alkoxy, hydroxyalkoxy, hydroxyalkenyl, hydroxyalkynyl, saccharide, carboxy, carboxyalkyl, carboxyamide, carboxyamidealkyl, amino, amido, aminoalkyl, phosphoalkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, tetrahydrotetrapyrane, thioalkyl, haloalkyl, haloalkenyl, haloalkynyl, alkyl ester, a site-directing molecule, a catalytic group, a reporter group, a binding agent, or a couple that is coupled to a site-directing molecule, to a catalytic group, to a reporter group, or to a binding agent;

ii) a lone pair of electrons, hydrogen, alkyl, aminoalkyl, alkylsulfone, carboxy alkyl, carboxyamidealkyl, phospho alkyl, alkyl sulfoxide, alkyl sulfone, alkyl sulfide, halo alkyl, aryl, N-oxide, dialkylamino, carbamate, or arylsulfonyl; and

or

at least two substituents are coupled to form a bridged structure, and when coupled to form a bridged structure, nonbridged substituents are as defined herein in paragraph i) or ii) other than for bridged substituents;

wherein R<sub>201</sub>-R<sub>216</sub> are other than hydrogen;

wherein when R<sub>301</sub>-R<sub>30m</sub> is other than a lone pair of electrons, Z is 1; and

wherein when R<sub>301</sub>-R<sub>30m</sub> is a lone pair of electrons, Z is 0.

116. The composition of Claim 91 wherein the macrocycle is complexed with a cationic species and the cationic species is a lanthanide or actinide cation.